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# United States Department of Agriculture,

## DIVISION OF BOTANY.

### CRIMSON CLOVER HAIR BALLS.

In connection with the comparatively recent introduction of crimson clover (fig. 1) as a forage plant and green manure in the United States, the following records of the injurious effect of crimson clover hay under certain conditions will be of interest, and will, it is hoped, enable farmers to avoid serious losses through carelessness in the use of this crop.

With a letter dated August 1, 1895, Mr. William P. Corsa forwarded to the Department a ball of peculiar appearance, stating that it had been taken from the stomach of a horse belonging to Joseph W. Messick, of Milford, Del., which had been eating crimson clover (*Trifolium incarnatum*), and the death of which was ascribed to the presence of the ball. The

statement was also made that Mr. Alexander Ryan a few days before had lost a horse from which two similar balls were taken. During the preceding year several horses had died in that vicinity under similar conditions, as many as thirty balls having been taken, it is said, from the stomach of a single horse. The writer wished to learn positively whether the balls could have been due to the feeding of crimson clover and whether any preventive could be recommended.



FIG. 1.—Crimson clover.

About the same time another letter, from an entirely different locality, Kellar, Va., written by B. W. Mears & Son, August 2, was received by the Department, accompanied by a ball taken from the stomach of a horse immediately after death. The statement was made that the horse had worked as usual without any signs of disease up to the time of its fatal illness. The horse was suddenly taken with intense pain and lived only five hours. Another ball similar to that taken from the stomach was found in the large intestine. Several other horses in the vicinity had died the preceding week, all apparently from the same cause, and the farmers had ascribed it to the feeding of crimson clover.

During the summer of 1895 Dr. Charles F. Dawson, of Washington, received from a veterinary surgeon of Raleigh, N. C., three balls which he had removed from the intestine of a horse after death. Dr. Dawson states that, from the correspondence which passed between the two at

the time, it is evident that the death of the horse was caused by these balls forming an impermeable wedge in the bowel, thus preventing the onward movement of the food materials and completely shutting off the intestinal blood vessels through the pressure exerted upon them. This was followed by peritonitis, gangrene, and the death of the animal.

The balls received from these three sources were uniform in all respects save size. They were almost exactly spherical, of yellowish brown color, with a smooth, even surface and firm texture, and were saturated with the intestinal juices. When dried the balls, which shrink little or none, vary in diameter from 3 to  $4\frac{1}{2}$  inches, are of a dull dun color, and have the appearance of a fine quality of felt. In texture the dried ball is so firm that its surface can not be indented with the thumb, yet in weight is unexpectedly light, one of the balls about 4 inches in diameter weighing only  $4\frac{3}{4}$  ounces. When cut open the ball is found to be solid and to consist of the same felt-like material throughout, showing faint, concentric layers of slightly different color. Upon examining the two surfaces of one of the felt-like layers with a strong lens, the mass is found to be composed of minute rather stiff hairs seldom more than one-tenth of an inch in length, sharply pointed at one end and either enlarged or abruptly broken at the other. Furthermore, the greater part of the hairs lie with the broken or enlarged end toward the center of the ball, the sharp end toward its surface. Scattered among the hairs there seems to be a small amount of earthy matter, not enough to discolor it or to be conspicuous in any way, but sufficient to dull rapidly a sharp knife used in slicing the mass. It is difficult or impossible to cut a smooth section through the middle of the ball either by sawing or by slicing, for toward the center its texture is much softer than at the surface and the hairs pack against the blade precisely as in cutting through a tightly compressed mass of cotton.

A comparison of these hairs with those of a mature plant of crimson clover shows the two to be identical. They vary in length from about one twenty-fifth to one-eighth of an inch, and under the microscope are found to consist each of a single plant cell with walls so thick that the cell cavity appears as a slender line running through the center of the hair. The apex tapers to a sharp point. The surface is provided with scattered, sharp-pointed tubercles bent toward the apex of the hair (fig. 2). In fresh specimens the hair is so transparent that these barbs usually can not be seen until the hair is stained, but in hairs taken from the balls, which are already stained to an amber color by the intestinal fluids, the barbs are at once evident.

It is only in the fully mature, overripe plant that the hairs become as stiff and well barbed as those found in the balls, and even then the stiff hairs are confined principally to the stalks of the flower heads and the calyxes of the separate flowers (fig. 3). In plants which are in flower or which have not yet flowered the hairs are soft and flexible.



FIG. 2.—Hair from a crimson clover hair ball, enlarged about 50 diameters; a, section of same still more enlarged.



If overripe crimson clover is fed to horses the bristly hairs will accumulate in the stomach or intestines in spherical balls, which are increased in size by repeated additions of the same matter to their surfaces, the whole mass tending to become more compact because most of the hairs, upwardly barbed, are constantly pushing toward the center, base foremost. When a ball has reached a sufficient size (whether after a few days or several weeks we have no means of knowing), it acts as a plug in the intestine, interfering with the vital functions, and finally, after a few hours of intense suffering, the horse dies from peritonitis or some related difficulty. It is wholly improbable that a ball, unless of enormous size, remaining in the stomach and not passing into the intestine would seriously affect the health of a horse. The occurrence of hair balls in the stomach or intestine of horses, and more commonly of cattle or sheep, is well known to veterinarians. Usually such balls are composed of hairs taken into the stomach little by little when the animals are licking their coats. These finally become matted into spherical concretions, often composed in part also of phosphatic salts or other finely divided alimentary refuse occupying the minute spaces between the hairs. In the center of the ball is frequently found a nail or some other hard object around which the first hairs had wrapped themselves when the formation of the ball was begun.

Hair balls made up of plant hairs have also been observed, consisting of the so-called "beards," or awns, of oats, barley, or other grain. In all the recorded cases the plant hairs are barbed, as in crimson clover, and it is doubtless true that only a plant with barbed hairs can cause trouble of this kind, unless the hairs are very long and flexible and can hold themselves together by wrapping around each other.

To explain the conditions under which the feeding\* of crimson clover proved so disastrous in certain parts of Delaware in 1895 it is to be noted that crimson clover when intended for hay is cut about the middle of May. If intended for a crop of seed the clover is left standing about three weeks longer. After cutting, the clover either is left one or two weeks in the cock and then thrashed directly from the field, or is stacked until a more convenient time for thrashing, often a month or longer. The increasing demand for crimson clover had induced an unusually large number of farmers in 1895 to save their crop for seed instead of hay. Consequently a larger amount than usual was left to mature its seed and many farmers had a short crop of clover hay, upon which they customarily depend at that season. After the middle of May they were



FIG. 3.—Mature calyx of crimson clover bearing the dried corolla, enlarged about 7 diameters.

\*A correspondent in Delaware has recently expressed his belief, based on an experience of several years in feeding crimson clover, that dampening the hay with water several hours before feeding entirely prevents the formation of hair balls.

forced to fodder their stock on overripe clover, and after the clover-seed harvest many of them fed their horses from the stack, or, worse yet, on the straw and refuse of the thrashing machines. Most of the deaths occurred in the latter half of July, at a time, therefore, when the horses had been kept on this improper diet from six to ten weeks.

Though crimson clover has long been in use in Europe as a forage plant, nothing appears to have been published there regarding its liability to form hair balls, and nothing, therefore, regarding treatment of cases. When the balls have once developed to such a size that they can not pass through the intestine no practical remedy can be suggested. But the prevention of the difficulty is in most cases easy. The hairs of crimson clover do not become stiff until the plant has passed the flowering stage and begun to ripen. It should be made a rule, therefore, never to feed crimson clover after the crop has ceased flowering, and especially never to follow the pernicious practice of feeding stock with the straw of crimson clover raised and thrashed as a seed crop. By guarding against improper methods of feeding there is no reason why crimson clover should not continue to maintain its well-merited reputation and increase in use as a forage plant and green manure.

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Approved :

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